

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES



In re the application of:
Hsueh Sung Tung, et al

Docket: H0005304

Serial Number: 10/626,997

Group Art Unit: 1621

Filed: July 25, 2003

Examiner: Chukwuma O. Nwaonicha

For: PROCESS FOR THE MANUFACTURE OF 1,3,3,3-TETRAFLUOROPROPENE

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is an Appeal to the Board of Patent Appeals and Interferences from the Final Rejection of claims 1, 3, 5-9, 11-17, 19-31, and 33-35 mailed December 1, 2005 in the above identified case. A Notice of Appeal is being filed concurrently herewith. An oral hearing is not requested.

The Commissioner is authorized to charge the required appeal brief fee of \$500.00 to Deposit Acct. No. 01-1125. The Commissioner is authorized to charge any other fees necessitated by this paper to Deposit Acct. No. 01-1125.

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I. REAL PARTY IN INTEREST

The real party in interest is Honeywell International, Inc., the assignee of record.

II. RELATED APPEALS AND INTERFERENCES

With respect to other appeals or interferences that will directly affect, or be directly affected by, or have a bearing on the Board's decision in this appeal, please note that there are no other related applications on appeal or subject to an interference known to appellant, appellant's legal representative or the assignee.

III. STATUS OF CLAIMS

The claims in the application are 1-35. Claims 1, 3, 5-9, 11-17, 19-31, and 33-35 are pending, stand rejected and are on appeal. Claims 2, 4, 10, 18, and 32 have been found to be allowable, but are objected to, as being dependent on rejected base claims.

IV. STATUS OF AMENDMENTS

No response was filed after final rejection.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The present invention claims a process for the manufacture of 1,3,3,3-tetrafluoropropene comprising :

- a) reacting 1-chloro-3,3,3-trifluoropropene with hydrogen fluoride in a reactor in the vapor phase and in the presence of a fluorination catalyst and under conditions sufficient to form an intermediate product which comprises 1-chloro-1,3,3,3-tetrafluoropropane and/or 1,1,1,3,3-pentafluoropropane; and
- b) reacting said intermediate product with a caustic solution and under conditions sufficient to dehydrochlorinate 1-chloro-1,3,3,3-tetrafluoropropane and/or to dehydrofluorinate 1,1,1,3,3-pentafluoropropane, forming a reaction product which comprises 1,3,3,3-tetrafluoropropene.

Support for this claim can be found throughout the specification, particularly on page 3 line 3 and after. Process step (a) is described in detail throughout the specification, particularly from page 3, line 25 through page 7, line 12. Process step (b) is described in detail throughout the specification, particularly from page 7, line 14 through page 8, line 12.

The invention further relates to a process for the manufacture of 1,3,3,3-tetrafluoropropene comprising :

- a) reacting 1-chloro-3,3,3-trifluoropropene with hydrogen fluoride in a reactor in the vapor phase and in the presence of a fluorination catalyst and under conditions sufficient to form an intermediate product which comprises 1-chloro-1,3,3,3-tetrafluoropropane and/or 1,1,1,3,3-pentafluoropropane; and
- b) thermally decomposing said intermediate product under conditions sufficient to dehydrochlorinate 1-chloro-1,3,3,3-tetrafluoropropane and/or to dehydrofluorinate 1,1,1,3,3-pentafluoropropane, forming 1,3,3,3-tetrafluoropropene.

The features of this embodiment are supported throughout the specification as well.

Process step (a) is described in detail throughout the specification, as stated above. Process step (b) is described in detail throughout the specification, particularly from page 8, lines 14 through 24.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

(a) Claims 1, 3, 5-9, 11-17, 19-31 and 33-35 stand rejected under 35 U.S.C. 103 over Elsheikh et al. (E1) (U.S. Patent 5,895,825), in view of Elsheikh et al. (E2) (U.S. Patent 6,124,510).

(b) Claims 2, 4, 10, 18, and 32 are objected to, as each being dependent on a rejected base claim.

VII. ARGUMENTS

(a) The Examiner has rejected claims 1, 3, 5-9, 11-17, 19-31 and 33-37 under 35 U.S.C. 103 over Elsheikh et al. (E1) (U.S. Patent 5,895,825) in view of Elsheikh et al (E2) (U.S. Patent 6,124,510). It is respectfully asserted that this ground of rejection is not well taken, since the inventive process is not taught or suggested by a combination of references E1 and E2.

The present invention relates to a process for the **manufacture of 1,3,3,3-tetrafluoropropene (HFC-1234ze)**. The two stage vapor phase process proceeds first with a hydrofluorination of 1-chloro-3,3,3-trifluoropropene (HCFC-1233zd) into 1-chloro-1,3,3,3-tetrafluoropropane (HCFC-244fa) and 1,1,1,3,3-pentafluoropropane (HFC-245fa), followed by the dehydrochlorination of HCFC-244fa and/or dehydrofluorination of HFC-245fa.

In one aspect of the invention, step (b) proceeds by a caustic step, thus:

1. A process for the manufacture of 1,3,3,3-tetrafluoropropene comprising :
 - a) reacting 1-chloro-3,3,3-trifluoropropene with hydrogen fluoride in a reactor in the vapor phase and in the presence of a fluorination catalyst and under conditions sufficient to form an intermediate product which comprises 1-chloro-1,3,3,3-tetrafluoropropane and/or 1,1,1,3,3-pentafluoropropane; and
 - b) reacting said intermediate product with a caustic solution and under conditions sufficient to dehydrochlorinate 1-chloro-1,3,3,3-tetrafluoropropane and/or to dehydrofluorinate 1,1,1,3,3-pentafluoropropane, forming a reaction product which comprises 1,3,3,3-tetrafluoropropene.

In another aspect of the invention, step (b) proceeds by a thermal decomposing step, thus:

22. A process for the manufacture of 1,3,3,3-tetrafluoropropene comprising :
 - a) reacting 1-chloro-3,3,3-trifluoropropene with hydrogen fluoride in a reactor in the vapor phase and in the presence of a fluorination catalyst and under conditions

sufficient to form an intermediate product which comprises 1-chloro-1,3,3,3-tetrafluoropropane and/or 1,1,1,3,3-pentafluoropropane; and
b) thermally decomposing said intermediate product under conditions sufficient to dehydrochlorinate 1-chloro-1,3,3,3-tetrafluoropropane and/or to dehydrofluorinate 1,1,1,3,3-pentafluoropropane, forming 1,3,3,3-tetrafluoropropene.

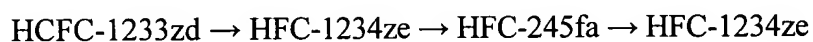
In each of these claim embodiments, the goal of the invention is the production of HFC-1234ze. However, the first cited reference E1 does not have the production of HFC-1234ze as a goal. Rather, the process of E1 serves solely to produce HFC-245fa. E1 first reacts HCFC-1233zd under conditions sufficient to form an intermediate admixture, which indeed comprises HFC-1234ze. However, E1 then converts the intermediate HFC-1234ze into HFC-245fa. HFC 1234ze does not remain as a final desired product of E1's process. It is urged that the process of E1 directly teaches away from step (a) of the present invention, where Applicant first reacts HCFC-1233zd with HF under conditions sufficient to form an *intermediate* admixture comprising *HFC-245fa*, and then *converts* the HFC-245fa into HFC-1234ze in subsequent step (b). Clearly the teachings of E1 directly contradict the present claims.

The examiner next cites reference E2, in combination with E1, pointing out E2's conversion of HFC-245fa into HFC-1234ze via a solution of potassium, sodium, calcium, or magnesium hydroxide. The Examiner takes the position that it would have been obvious for one skilled in the art to formulate the presently claimed invention upon a combining of E1 and E2. However, it submitted that the Examiner is impermissibly reconstructing the art in light of the Applicant's disclosure.

First, neither of the cited references teach or suggest step (a) of the present invention, much less the particular combination of step (a) followed by step (b) to produce a final product of HFC-1234ze. Setting aside for the moment the production of the HCFC-244fa, the present step (a) is conducted by reacting HCFC-1233zd with HF in a reactor in the vapor phase and in the presence of a fluorination catalyst, *under conditions sufficient to*

form *HFC-245fa*, which is thereafter reacted in step (b) to produce HFC-1234ze. In contrast, E1 reacts HCFC-1233zd with HF in a reactor in the vapor phase and in the presence of a fluorination catalyst and *under conditions sufficient* to form an intermediate mixture which primarily contains *HFC-1234ze*. As stated above, this intermediate HFC-1234ze is thereafter converted into HFC-245fa. Obviously the applicant's conditions, which produce HFC-245fa would inherently be different from E1's conditions which produce HFC-1234ze.

Indeed E2 discloses a method for forming HCFC 1234ze from HFC-245fa. However, as stated above, E2 fails to teach step (a) of the present invention where the intermediate material containing HCFC-244fa and HFC-245fa is formed. Furthermore, it is urged that one skilled in the art would not be motivated to combine E1 with E2 to ultimately produce HFC-1234ze, since this combination would require *multiple conversions*. That is, a hypothetical combination of E1 and E2 would convert:



This would be an illogical pathway from HCFC-1233zd to HFC-1234ze, since HFC-1234ze would be converted into HFC-245fa and then converted back to HFC-1234ze. Thus, it is urged that one skilled in the art would not be motivated to combine E1 and E2 in order to obtain HFC-1234ze from HCFC-1233zd. The fact that one *could* obtain HFC-1234ze from HCFC-1233zd from a hypothetical combination of E1 + E2, does not mean that one *should* do so, or that this would be successful in practice.

Appellants submit that the Examiner is looking far beyond the teachings of the references. Citing references that merely indicate that isolated elements recited in the claims are known is not a sufficient basis for a conclusion of obviousness; there must be something that suggests the desirability of combining the references in a manner calculated to arrive at the claimed invention. Ex parte Hiyamizu, 10 U.S.P.Q.2d 1393, 1394 (PTO Bd. Pat. Ap. and Int., 1988). A reference has to offer sufficient motivation for

one skilled in the art to achieve the desired result. In the instant case, the motives in the references, as disclosed by the practices therein, are quite different from each other as well as those of the instant invention. The present invention, therefore, is not made obvious by the combination the Examiner has suggested, and the 35 U.S.C. 103 rejections should, therefore, be overruled. "Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination." In re Geiger, 2 U.S.P.Q.2d 1276, 1278 (CAFC 1987).

It is pointed out that that the Applicants do not claim all pathways of proceeding from HCFC-1233zd to HFC-1234ze. Likewise the Applicants are not claiming the concept of proceeding from HCFC-1233zd to HFC-1234ze. Instead, Applicants are claiming a *particular technique* of proceeding from HCFC-1233zd to HFC-1234ze which is not apparent from a hypothetical combination of E1 and E2. For these reasons it is submitted that a combination of E1 and E2 does not obviate the instant invention, and it is respectfully requested that the above rejection be overruled.

(b) The Examiner has objected to claims 2, 4, 10, 18, and 32 as each being dependent on a rejected base claim. The Examiner previously stated that all of these claims would be allowable if rewritten in independent form. It is submitted that the rejections of the base claims should be withdrawn in view of the above arguments, thereby obviating the objections to claims 2, 4, 10, 18, and 32. It is therefore respectfully submitted that these objections should be withdrawn in view of the above arguments.

None of the cited references, taken alone or in combination, teaches or suggests the invention claimed by Applicants. For all the above reasons, claims 1-35 are urged to be

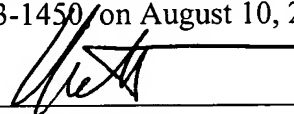
patentable over the cited references, and the rejections under 35 U.S.C.103 should be overruled.

Respectfully submitted,



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I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail, postage pre-paid in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on August 10, 2006.



Richard S. Roberts

VIII. CLAIMS APPENDIX

1. A process for the manufacture of 1,3,3,3-tetrafluoropropene comprising :
 - a) reacting 1-chloro-3,3,3-trifluoropropene with hydrogen fluoride in a reactor in the vapor phase and in the presence of a fluorination catalyst and under conditions sufficient to form an intermediate product which comprises 1-chloro-1,3,3,3-tetrafluoropropane and/or 1,1,1,3,3-pentafluoropropane; and
 - b) reacting said intermediate product with a caustic solution and under conditions sufficient to dehydrochlorinate 1-chloro-1,3,3,3-tetrafluoropropane and/or to dehydrofluorinate 1,1,1,3,3-pentafluoropropane, forming a reaction product which comprises 1,3,3,3-tetrafluoropropene.
2. The process of claim 1 wherein the intermediate product comprises 1-chloro-1,3,3,3-tetrafluoropropane.
3. The process of claim 1 wherein the intermediate product comprises 1,1,1,3,3-pentafluoropropane.
4. The process of claim 1 wherein the intermediate product comprises both 1-chloro-1,3,3,3-tetrafluoropropane and 1,1,1,3,3-pentafluoropropane.
5. The process of claim 1 which comprises reacting the trans isomer form of 1-chloro-3,3,3-trifluoropropene.
6. The process of claim 1 which comprises reacting the cis isomer form of 1-chloro-3,3,3-trifluoropropene.
7. The process of claim 1 which comprises reacting both the trans and cis isomer forms of 1-chloro-3,3,3-trifluoropropene.

8. The process of claim 1 wherein said caustic solution comprises NaOH, KOH, Ca(OH)₂, CaO or combinations thereof.
9. The process of claim 1 wherein said dehydrochlorination of 1-chloro-1,3,3,3-tetrafluoropropane and said dehydrofluorination of 1,1,1,3,3-pentafluoropropane are conducted simultaneously in the same reactor.
10. The process of claim 1 wherein step (b) is conducted by first separating 1-chloro-1,3,3,3-tetrafluoropropane and 1,1,1,3,3-pentafluoropropane, and then separately dehydrochlorinating 1-chloro-1,3,3,3-tetrafluoropropane with said caustic solution and separately dehydrofluorinating 1,1,1,3,3-pentafluoropropane with said caustic solution.
11. The process of claim 1 wherein said fluorination catalyst is selected from the group consisting of transition metal halides, Group IVb metal halides, Group Vb metal halides and combinations thereof on activated carbon or fluorinated alumina.
12. The process of claim 1 wherein said fluorination catalyst is selected from the group consisting of SbCl₅, SbCl₃, TaCl₅, SnCl₄, NbCl₅, TiCl₄, MoCl₅, Cr₂O₃, Cr₂O₃/Al₂O₃, Cr₂O₃/AlF₃, Cr₂O₃/carbon, CoCl₂/Cr₂O₃/Al₂O₃, NiCl₂/Cr₂O₃/Al₂O₃, CoCl₂/AlF₃, NiCl₂/AlF₃ and combinations thereof.
13. The process of claim 1 wherein said fluorination catalyst is selected from the group consisting of Cr₂O₃, Cr₂O₃/AlF₃, CoCl₂/AlF₃, NiCl₂/AlF₃ and combinations thereof.
14. The process of claim 1 wherein said fluorination catalyst comprises SbCl₃ or SbCl₅ supported on activated carbon.
15. The process of claim 1 wherein the reaction of step (a) is conducted at a temperature of from about 50°C to about 200°C.

16. The process of claim 1 wherein the reaction of step (a) is conducted at a pressure of from about 15 psia and 215 psia.
17. The process of claim 1 wherein the mole ratio of hydrogen fluoride to 1-chloro-3,3,3-trifluoropropene is from about 1:1 to about 50:1.
18. The process of claim 1 further comprising feeding chlorine to the reactor to keep the catalyst active.
19. The process of claim 1 wherein the reaction of step (b) is conducted at a temperature of from about 20°C to about 100°C.
20. The process of claim 1 wherein the reaction of step (b) is conducted at atmospheric pressure.
21. The process of claim 1 wherein the caustic strength of said caustic solution is from about 2 wt % to about 100 wt %.
22. A process for the manufacture of 1,3,3,3-tetrafluoropropene comprising :
- a) reacting 1-chloro-3,3,3-trifluoropropene with hydrogen fluoride in a reactor in the vapor phase and in the presence of a fluorination catalyst and under conditions sufficient to form an intermediate product which comprises 1-chloro-1,3,3,3-tetrafluoropropane and/or 1,1,1,3,3-pentafluoropropane; and
 - b) thermally decomposing said intermediate product under conditions sufficient to dehydrochlorinate 1-chloro-1,3,3,3-tetrafluoropropane and/or to dehydrofluorinate 1,1,1,3,3-pentafluoropropane, forming 1,3,3,3-tetrafluoropropene.
23. The process of claim 22 wherein step (b) is conducted at a temperature of from about 30°C to about 400°C.

24. The process of claim 22 wherein step (b) is conducted at a temperature of from about 50°C to about 350°C.

25. The process of claim 22 wherein step (b) is conducted at a temperature of from about 75°C to about 300°C.

26. The process of claim 22 wherein step (b) is conducted at atmospheric pressure.

27. The process of claim 22 wherein step (b) is conducted in the presence of a catalyst.

28. The process of claim 22 wherein step (b) is conducted in the presence of a catalyst selected from the group consisting of supported or bulk transition metal halides.

29. The process of claim 27 wherein the catalyst is selected from the group consisting of iron halides, nickel halides, cobalt halides and combinations thereof.

30. The process of claim 27 wherein said catalyst comprises supported or bulk FeCl_3 , NiCl_2 or CoCl_2 .

31. The process of claim 22 wherein said dehydrochlorination of 1-chloro-1,3,3,3-tetrafluoropropane and said dehydrofluorination of 1,1,1,3,3-pentafluoropropane are conducted simultaneously in the same reactor.

32. The process of claim 22 wherein step (b) is conducted by first separating 1-chloro-1,3,3,3-tetrafluoropropane and 1,1,1,3,3-pentafluoropropane, and then separately thermally dehydrochlorinating 1-chloro-1,3,3,3-tetrafluoropropane and separately thermally dehydrofluorinating 1,1,1,3,3-pentafluoropropane.

33. The process of claim 22 wherein said fluorination catalyst is selected from the group consisting of transition metal halides, Group IVb metal halides, Group Vb metal halides and combinations thereof on activated carbon or fluorinated alumina.

34. The process of claim 22 wherein said fluorination catalyst comprises SbCl_3 or SbCl_5 supported on activated carbon.

35. The process of claim 22 wherein the mole ratio of hydrogen fluoride to 1-chloro-3,3,3-trifluoropropene is from about 1:1 to about 50:1.

IX. EVIDENCE APPENDIX

None.

X. RELATED PROCEEDINGS APPENDIX

None.